Electronic Services - Hayward, Ca
M21433X

INSTRUCTION MANUAL
FOR
MODEL 7001
T1 FAULT LOCATOR

ISSUE 2

NORTHEAST ELECTRONICS CORPORATION

P.O. BOX 649 – CONCORD, N.H. 03301

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SECTION 1

GENERAL DESCRIPTION

1.1 PURPOSE OF THE EQUIPMENT. The T1 Fault Locator is a specialized test set for troubleshooting a failed T1 Repeater Line to determine the point of failure. It contains a 1.544 megabit pulse rate signal generator adjustable to any of four modes of operation, a range of pulse densities, a modulating signal adjusted to one of 12 modulating frequencies spaced across the voice band, and a sensitive voice-frequency selective detector pretuned to the modulating signal frequency.

1.2 Of the four modes of operation, the normal mode, switch position MEAS 1, sends a deliberate bipolar violation following each pair of bipolar pulses and reverses the polarity of the violations at the selected voice-frequency rate. The second and third modes, MEAS 2 and MEAS 3, are the same as the normal mode except that in the MEAS 2 position only negative polarity violations are transmitted and in the MEAS 3 position, only positive polarity violations are transmitted, in both cases, in bursts occurring at the selected voice-frequency rate. The fourth mode, BIPOLAR, sends no bipolar violations at all and can be used as a normal bipolar signal of adjustable pulse density for test purposes.

1.3 The signal generator mode, pulse density, and voice frequency selection functions are controlled by pushbutton switches. The received level of the voice-frequency signal transmitted from a normally operating line repeater over the voice-frequency fault locating line is determined from the setting of a rotary switch in combination with the reading of a panel meter. Received signal levels from +3 to -95 dBm are indicated directly.

1.4 Jacks are provided for connecting to the T1 repeater line, the fault locating line, an error detector for monitoring the bipolar violations, and for monitoring the fault locating line.

1.5 The set is portable and can be operated in either the vertical or the horizontal position. The cover is removable and provides storage for the power cord.

SECTION 2

SPECIFICATIONS

a. SIGNAL GENERATOR

Clock Frequency:
1.544 MHz ±200 Hz

Operating modes:

MEAS 1 - one bipolar pulse pair per selected pulse period with one bipolar violation alternating from positive to negative at a selected audio frequency rate.

MEAS 2 - one bipolar pulse pair per selected pulse period with one negative bipolar violation alternately on and off at a selected audio frequency rate.

MEAS 3 - one bipolar pulse pair per selected pulse period with one positive bipolar violation alternately on and off at a selected audio frequency rate.

BIPOLAR - one bipolar pulse pair per selected pulse period.

Pulse periods: 4 to 11 time slots.

AUDIO FREQUENCIES:

Switch Pos.	Freq. ±2%
A	832
B	928
C	1048
D	1206
E	1340
F	1508
G	1722
H	2008
J	2193
K	2413
L	2680
M	3017

Pulse Amplitude:
3 volts ±10% into 100Ω line

Pulse Width:
0.324μseconds ±10%

b. SELECTIVE DETECTOR

Sensitivity:
+3 to -95 dBm from 900Ω line

Audio Frequencies:
mid-band frequencies same as Signal Generator.

Pulse Period Normalizing Pads:

Pulse Period	Loss dB
11	.0
10	0.8
9	1.8
8	2.8
7	4.0
6	5.3
5	6.8
4	8.8

Band Width:
6% at 3 dB points

Rejection:
20 dB at 10% points

c. POWER REQUIREMENTS:
105-135V ac, 50/60 Hz, 8 watts

d. WEIGHT:
12 lb.

e. SIZE:
$8\frac{3}{4}$" x 12" x $10\frac{1}{2}$"

f. TEMPERATURE RANGE:
0 to 50°C

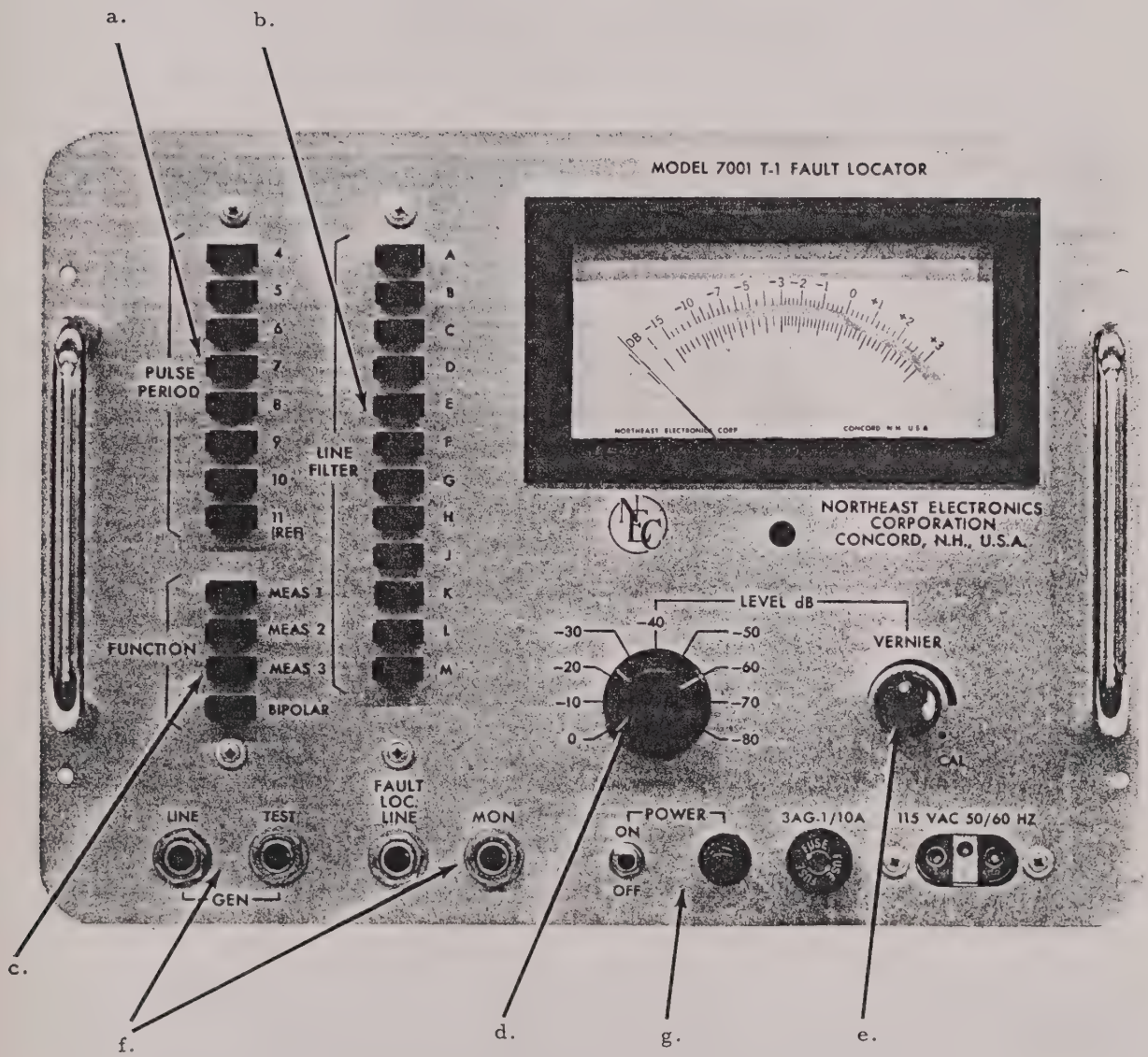


Fig. 3-1 Front Panel Controls

SECTION 3

OPERATING INSTRUCTIONS

3.1 FRONT PANEL CONTROLS (See Fig. 3-1).

a. PULSE PERIOD- used to control the density of the pulses transmitted. Each period contains either two or three pulses depending on the position of the FUNCTION switch. The push-button switches are interlocked so that only one at a time is operated. Each switch also inserts a normalizing pad in the detector to maintain constant response for varing pulse periods.

b. LINE FILTER- used to control the frequency of modulation of the signal generator and selection of the tuned detector. Each frequency corresponds to the mid-band frequency of an interrogation filter at a repeater location. The letters A through M are the letter codes of the corresponding Western Electric 598-type interrogation filters.

c. FUNCTION - pushbutton switches operated one at a time to select one of four signal generator modes to compare with the incoming signal from the fault locating line.

d. LEVEL - used to control the sensitivity of the tuned detector in 10 dB steps.

e. VERNIER - continuously cariable attenuator in tandem with LEVEL control, used to normalize meter reading for margin tests.

f. Input and Output jacks for 310-type plugs. GEN output jacks: LINE for patching signal generator output to 100Ω balanced repeatered line and TEST for bridging an error detector across the generator output. FAULT LOC LINE jack for patching the output of the 900Ω balanced fault locating line to the input of the selective detector.

g. POWER ON/OFF - switch and indicator light, 3AG 1A replaceable fuse and 3-pin connector for 115V ac 50/60 Hz power cord.

3.2 OPERATION. The T1 Fault Locator generates a 1.544 megabit pulse rate signal which feeds a T1 repeater line. This signal is modulated in the Fault Locator by one of 12 voice frequencies, each of which may be associated with a repeater location. In a properly operating repeatered line, the voice frequency component of this signal is returned from the associated repeater location through a separate Fault Locating pair and is measured in the Fault Locator by a selective detector tuned to the same voice frequency. Optional modes of operation of the signal generator aid in determining partial failures of a repeater and provide an unmodulated signal for other purposes.

3.3 OPERATING PROCEDURE - Transmission Test for Locating a Total Line Failure.

a. Patch GEN LINE jacks to input of repeatered line to be tested and FAULT LOC LINE jack to associated fault locating line.

b. Operate FUNCTION switch to MEAS 1; PULSE PERIODS switch to 11 (REF); VERNIER LEVEL control maximum CW.

c. Operate the LINE FILTERS switch to the frequency corresponding to the mid-band frequency of the interrogation filter at the repeater nearest the office. The frequencies corresponding to switch positions A-M are listed in Section 2 part a.

d. Adjust the LEVEL switch for an on-on-scale meter reading. The expected level is approximately -65dBm minus the loss of the fault locating line.

e. Operate the FUNCTION switch to MEAS 2. The received level should drop 4 to 8 dB.

f. Operate the FUNCTION switch to MEAS 3. The received level should be within 1 dB of the value observed in e.

g. Operate the FUNCTION switch to BIPOLAR. The received level should drop at least 10 dB from the value observed in e or f.

h. Repeat steps c through g. for each repeater in turn in order of nearness to the transmitting office. For each repetition, the LINE FILTERS switch is operated to the frequency corresponding to that of the interrogation filter at the desired repeater location. If the line has failed at any point, no signal (except line noise) will be returned from any repeater beyond that point. The first repeater to return no signal, therefore, is to be suspected of malfunction. If the line noise is exceptionally high, it may be due to oscillations from one or more idle lines in the same complement. If there are such idle lines, they should be either disabled by removing power or activated by feeding in a normal signal for the duration of the fault locating test. Such a signal can be supplied from a bridging repeater in the office, a spare terminal or another T1 Fault Locator set for a BIPOLAR signal.

3.4 OPERATING PROCEDURE. Margin Test for Locating a Marginally Operating Repeater.

a. Having first completed paragraph 3.3 leave patches or repatch from test set to repeatered line and fault locating line as in 3.3a.

b. For each applicable position of the LINE FILTERS switch in turn, go through the following steps.

c. With the FUNCTION switch in the MEAS 1 position and the PULSE PERIODS switch at 11 (REF), adjust the LEVEL switch and VERNIER to give a zero reading on the meter.

d. Without changing the VERNIER control, operate the PULSE PERIODS switch to each position in turn and note the corresponding meter reading for each position.

e. For a normally operating line, it is expected that for PULSE PERIODS 10, 9 and 8, the meter deflection from the adjusted value established in 2, 4c will be less than 0.5 dB. As each repeater is stressed further by operating the PULSE PERIOD switch is 7, 6, 5 and 4 in turn, the meter deflection will usually exceed 0.5 dB at a pulse period which depends on the operating margin of the repeater being tested or of another repeater nearer the office. A poor repeater may cause more than 0.5 dB meter deflection for PULSE PERIODS as high as 8, 9, or 10 and will affect the indication of all other repeaters farther away from the office.

SECTION 4

CIRCUIT DESCRIPTION

4.1 GENERAL DESCRIPTION. The major functions performed by the T1 Fault Locator are indicated in the block diagram of Fig. 4-1.

4.2 The CLOCK is basically a crystal-controlled oscillator of 1.544 megahertz (MHz) nominal frequency and a squaring circuit which produces a 5 Volt positive 50% duty cycle pulse per cycle.

4.3 The COUNTER with its four stages produces pulses of 2, 4, 8 and 16 times the pulse width of the clock pulses at correspondingly reduced pulse rates.

4.4 Combinations of the COUNTER output signals are controlled by the PULSE CONTROL circuits. The combinations are selected by manually operated pushbutton switches to determine the repetition rate of the final signal.

4.5 The FUNCTION GENERATOR circuits generate the component pulses required to produce the four types of signals to be repeated in each pulse period. Combinations of these component pulses are selected by manually operated pushbutton switches and fed into the MODULATOR for further processing.

4.6 The MODULATOR is also fed by voice frequency pulses from the VF OSCILLATOR. The oscillator frequency is controlled by manually operated pushbutton switches in the VF SELECTOR so that the modulation frequency of the line signal corresponds to one of 12 narrow band frequencies of the interrogation filters along the line.

4.7 The DRIVER circuit converts the train of unipolar pulses, one side grounded, to pulses of alternate polarities in each pulse period in a circuit balanced to ground.

4.8 In the receiving direction, the buffer amplifier, preceded by the "40 dB step" portion of the level control and followed by the "10 dB step" portion of the level control, accepts incoming voice frequency signals over a range of 98 dB in amplitude to give an on-scale meter indication. The circuit contains fixed gain, a tuned 60 Hz rejection filter, and adjustable loss.

4.9 The VF SELECTOR not only controls the modulation frequency of the outgoing signal, but also controls the mid-frequency of a narrow band active filter to the same nominal value. This filter further reduces the interfering effect of line noise at frequencies outside of the band pass.

4.10 The PULSE PERIOD NORMALIZER adjusts the sensitivity of the detector to compensate for the variation in signal generator line power resulting from variation of the pulse period, thus automatically recalibrating the detector for each pulse period.

4.11 The METER DETECTOR circuit converts the incoming filtered signal to direct current which operates the meter.

4.12 The basic pulse patterns which can be sent out on the T1 line by the signal generator are shown in Fig. 4-2. In all four of these patterns the pulse density may be caried by adjusting the length of the pulse period from 11 polar positions to 4 pulse positions. In all except the BIPOLAR pattern, which has no VF component, the length of the VF CYCLE may also be varied by adjusting the frequency of the modulating voice signal to correspond to the mid-band frequency of one of the 12 interrogation filters which may be installed on the line.

4.13 SIGNAL GENERATOR. The signal generator is a hybrid of medium-power, high-speed, integrated-circuit logic elements and discreet transistor circuits. The logic convention is high true, with logical one (1) corresponding to +5 V, logical zero (0) OV. Fig. 4-3 illustrates the logical sequence of the signal generator.

a. CLOCK: Transistor Q1 and associated components form a crystal-controlled Colpitts oscillator operating at 1.544 MHz. Transistor Q2 interfaces the oscillator with OR gate U1 which functions as a Schmitt trigger, or squaring circuit, to generate the clock pulse train (CL). Width of the clock pulse is controlled by R7 (PW).

b. COUNTER: Integrated circuit U2 functions as a 4-bit ripple binary counter. The four binary outputs (A, B, C and D) and their complements produced by the quad NOR gates of U3 are appropriately decoded to generate the pulse period timing and pulse functions.

c. PULSE PERIOD CONTROL: The NOR gates of U4 and U5A in conjunction with the PULSE PERIOD switch, S2A, combine the counter outputs to produce a reset pulse. This pulse is gated with the clock pulse, forcing the counter to recycle repetitively at a rate corresponding to the selected pulse period.

d. FUNCTION GENERATOR: NOR gate U5B and U6 combine the counter outputs to produce pulses corresponding to component pulse "2", and pulses "1" and "1 + 3", respectively. Combinations of the component pulses are selected by the FUNCTION switch S2B and are subsequently applied to the MODULATOR for further processing.

e. VF OSCILLATOR: Transistors Q4, Q5, Q6, Q7 and associated components form a voltage-controlled bistable multivibrator operating at twice the required voice frequency. The frequency is controlled by a voltage divider on the VF SELECTOR. Frequency calibration is provided by R23 (F). Transistor Q3 serves as interface between the multivibrator and NOR gate U9B, which in turn drives the JK binary element U7. The complimentary outputs of U2 (F and E) are precise square waves having a fundamental frequency equal to the selected voice frequency. $\overline{F}$ and $\overline{E}$ are applied to the MODULATOR in the MEASURE 1, 2 and 3 FUNCTION settings. In the Bipolar FUNCTION setting, the JK binary is forced to reset (output F is held at logical zero), thus disabling the VF signal.

f. MODULATOR: The MODULATOR is composed of NOR gates U8 and U9A. Here the function generator and VF OSCILLATOR outputs are gated to produce the positive and negative portions of the output signal: hence, for measure 1, 2, and 3 components "1", "2", and "1 + 3" are combined with the VF OSCILLATOR output to produce the desired pattern; for BIPOLAR, only components "1" and "2" are present.

g. DRIVER: The MODULATOR outputs at U9A are gated with the clock pulse at U10, which in conjunction with T1 form a push-pull output stage to deliver the final output signal to the LINE jack. Output level adjustment is provided by R24 (H), Q8 and associated components. The output is balanced to chassis through R26.

4.14 BUFFER AMPLIFIER. The buffer amplifier is a single input, single ended integrated circuit amplifier having a restricted bandwidth and an input impedance greater than 90K over the T1 Fault Locating frequencies. The input is a.c. coupled. The input looks into a biased emitter follower circuit which functions as an impedance converter for an L-C 60 Hz reject filter, the output is a.c. coupled to a wide band amplifier, having 50 dB of gain. This gain is obtained by the use of feedback resistors R8 and R7. The output is a.c. coupled to external circuits.

4.15 VOICE FREQUENCY SELECTOR. The voice frequency selector is a single input, single ended two pole active Wein bridge filter. The filter consists of two identical amplifiers, each relying on reactive and non-reactive feedback for filter characteristics. The reactive

positive feedback provides shaping, the non-reactive negative feedback provides stability. The overall gain is a function of both positive and negative feedback at resonance and is approximately 20 dB. The first stage input is a.c. coupled; negative feedback is established by the path of R14 in series with R15 gain adjust potentiometer. Positive feedback is established by components both on and off the printed circuit board. The local components are capacitive and are fixed in value for all frequencies, while the components not appearing on this board are resistive and are different in value from one frequency to another. These frequency determining resistors are inserted into the circuit by operating the push button LINE SELECTOR switch.

4.16 METER DETECTOR. The meter detector is comprised of a wide-band amplifier and a full wave bridge rectifier which develops the d.c. driving current for the meter. The amplifier is a.c. coupled and is d.c. biased midway between supply and common by resistors R22 and R23. The amplifier output is used as a d.c. bias for transistors Q2 and Q3 which provide current gain for the bridge, and as a signal source to drive the bridge. The output of the bridge is used as negative a.c. and d.c. feedback for the amplifier and as d.c. drive through series resistors R27 and R28. Gain is determined by the series resistor R24, and gain adjust potentiometer R25.

4.17 POWER SUPPLIES. The power supply circuits convert line derived a.c. Power to the 5 and 24 Volt d.c. levels appearing throughout the instrument. The raw d.c. for the twenty-four Volt regulator is provided by a full wave bridge and filtered by the capacitor C1. The integrated circuit voltage regulator U1 is powered by the bridge through series limiting resistor R1. The series pass transistor Q1 is powered directly by the bridge and driven by the emitter output of U1. The diodes CR9 through CR12 assure that the supply voltage for U1 never drops below the operating voltage necessary to regulate twenty-four Volts, which appears at the emitter of Q1. Also attached to the emitter of Q1 is a voltage divider circuit which senses variations in output voltage for regulation and serves as a voltage adjustment. The output capacitor C3 is a final filtering stage.

4.18 The raw d.c. for the five Volt regulator circuit is provided by a full wave bridge and filtered by the capacitor C4. The regulator circuit consists of a differential amplifier and current source, the output of which is used to drive a Darlington pair, which serves as the series pass element. The reference for the differential amplifier is provided by a division of the regulated twenty-four Volts, while the feedback is provided by an adjustable voltage division of the regulated five Volts. The output capacitor C5 is a final filtering stage.

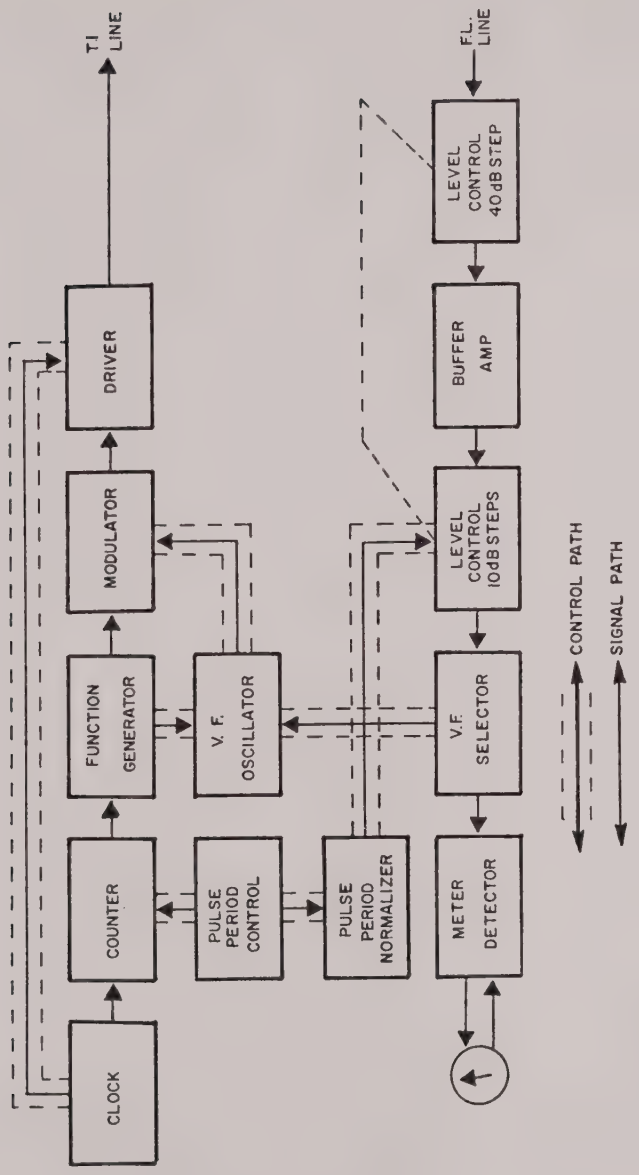


Figure 4-1 Model 7001 Block Diagram

Figure 4-2 Signal Generator Timing Diagram.

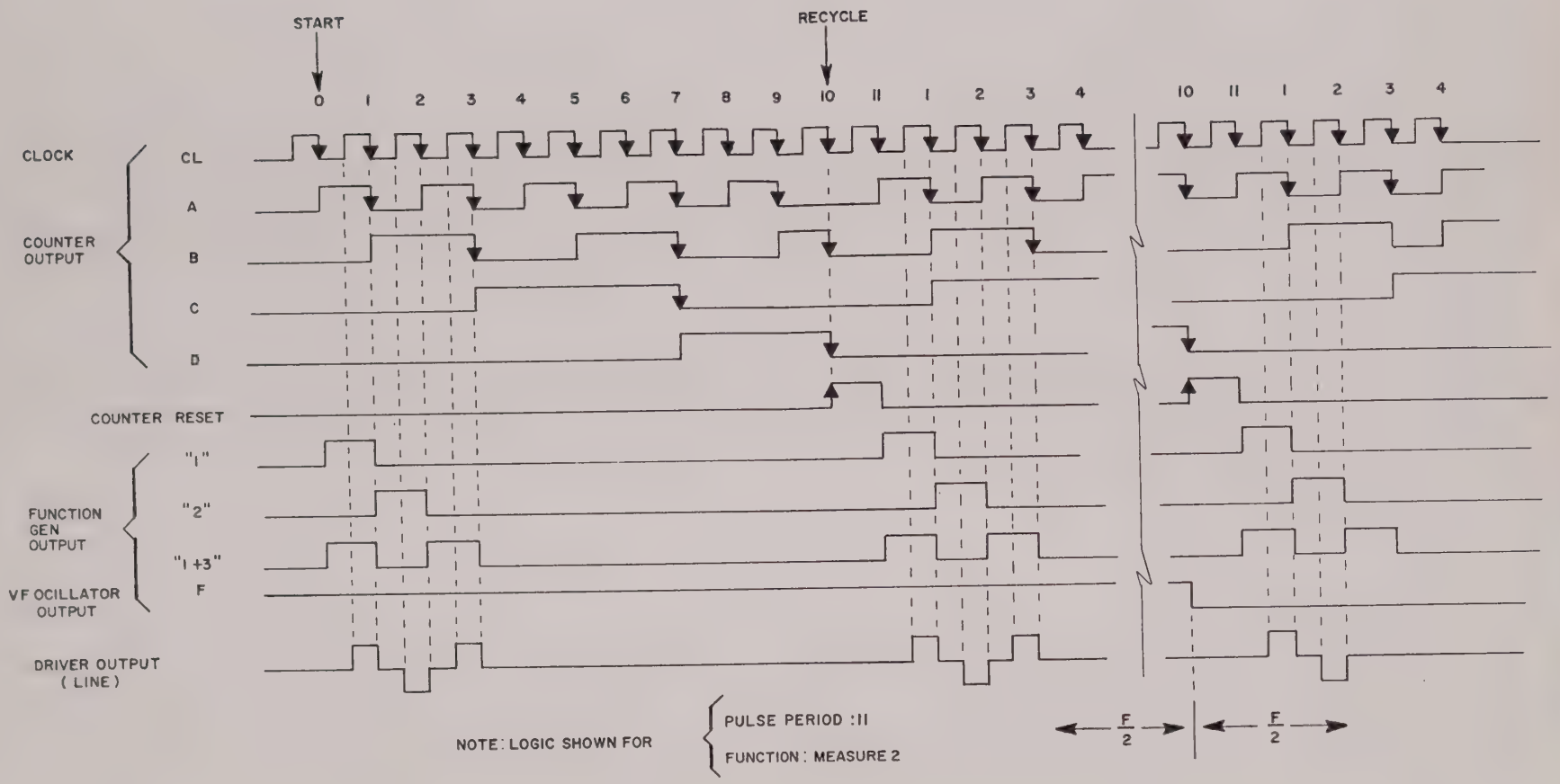


Figure 4-2 Signal Generator Timing Diagram.

SECTION 5

MAINTENANCE AND CALIBRATION

5.1 There are no specific Maintenance and Calibration instructions for the Model 7001. If a fault occurs within the set it is suggested that the set be returned to the manufacturer for repair, observing the instructions under the warranty printed on the reverse side of the title page for this manual.

5.2 All internal adjustments are factory set and should not be readjusted by the user.

SECTION 6

ELECTRONIC PARTS LIST

6.1 INTRODUCTION. The following pages contain the parts list for the Model 7001.

6.2 FSCM Code Numbers. The Federal Supply Code of Manufacturers of each part. A list of these codes and their respective manufacturers is given below.

Code	Manufacturer
00124	Veeco Instruments Inc. Plainview, LI, N.Y. 11803
01121	Allen Bradley Milwaukee, Wis. 53204
01295	Texas Instrument Inc. Dallas, Texas 75231
05397	Kemet Div. of Union Carbide N.Y., N. Y. 10017
05844	Callins Industries Inc. Greenfield, Tenn. 38230
06486	IRC Div. of TRW Inc. Lynn, Mass. 01905
06555	Beede Electric Instruments Penacook, N.H. 03301
06819	Northeast Electronic Corp. Concord, N.H. 03301
09353	C&K Components Inc. Newton, Mass. 02158
12065	Transitron Electronic Corp. Boston, Mass. 02128
13606	Sprague Electric Co. Concord, N.H. 03301
15873	Motorola Inc. Arcade, N.J. 14009
17117	Electronic Moulding Corp. Pawtucket, RI. 02860
17538	Precision Electronics Mansfield, Mass. 02050
17803	Fairchild Semi Conductor Mountain View, Calif. 94041
18043	Profile Electronics Concord, N.H. 03301
18324	Signetics Corp. Sunnyvale, Calif. 94086
22650	Whale Electronics Nashvile, Tenn.
49671	RCA Corp. N.Y., N. Y. 10020
49956	Raytheon Co. Lexington, Mass. 02173
71400	Bussman St Louis, Mo. 63017
71450	CTS Corp. Elkhart, Ind. 46514
71590	Centralab Milwaukee, Wis. 53201
71744	Chicago Minature Lamp Chicago, Ill. 60640
72136	Electro Motive Mfg. Willimantic, Conn. 06226
76493	Miller J.W. Company Compton, Calif. 90024
76854	Oak Mfg. Co. Crystal Lake, Ill. 60014
79066	Valpey Corp. Holliston, Mass. 01746
80223	United Transformer Co. N.Y., N. Y. 10013
80294	Bourns Inc. Riverside, Calif. 92507
81095	Triad Transformer Corp. Venice, Calif. 90293
82389	Switchcraft Inc. Chicago, Ill. 60630
91506	Augat Inc. Attleboro, Mass. 02703
91662	Elco Corp. Willow Grove, Pa. 19090
	Electra/Midlands Corp. Mineral Wells, Texas

PC Board E95645 (E07-001-00-020)

Ref Desig.	Description	Manufacturer (FSCM Code No.)	Part Number
R1	R: 17.8K ±¼% 1/8W	Electra/Midlands	MFSC
R1A	R: 2.0M ±1% ¼W	Electra/Midlands	MFSC
R2	R: 17.4K ±¼% 1/8W	Electra/Midlands	MFSC
R2A	R: 1.21M ±1% ¼W	Electra/Midlands	MFSC
R3	R: 15.4K ±¼% 1/8W	Electra/Midlands	MFSC
R4	R: 16.2K ±¼% 1/8W	Electra/Midlands	MFSC
R4A	R: 715K ±1% 1/8W	Electra/Midlands	MFSC
R5	R: 12.4K ±¼% 1/8W	Electra/Midlands	MFSC
R5A	R: 698K ±1% 1/8W	Electra/Midlands	MFSC
R6	R: 11.8K ±¼% 1/8W	Electra/Midlands	MFSC
R7	R: 14.0K ±¼% 1/8W	Electra/Midlands	MFSC
R8	R: 13.7K ±¼% 1/8W	Electra/Midlands	MFSC
R8A	R: 1.5M ±1% ¼W	Electra/Midlands	MFSC
R9	R: 11.0K ±¼% 1/8W	Electra/Midlands	MFSC
R9A	R: 332K ±1% 1/8W	Electra/Midlands	MFSC
R10	R: 11.3K ±¼% 1/8W	Electra/Midlands	MFSC
R10A	R: 374K ±1% 1/8W	Electra/Midlands	MFSC
R11	R: 9.53K ±¼% 1/8W	Electra/Midlands	MFSC
R11A	R: 1.21M ±1% ¼W	Electra/Midlands	MFSC
R12	R: 9.76K ±¼% 1/8W	Electra/Midlands	MFSC
R13	R: 7.32K ±¼% 1/8W	Electra/Midlands	MFSC
R14	R: 7.15K ±¼% 1/8W	Electra/Midlands	MFSC
R14A	R: 1.07M ±1% ¼W	Electra/Midlands	MFSC
R15	R: 8.66K ±¼% 1/8W	Electra/Midlands	MFSC
R15A	R: 590K ±1% 1/8W	Electra/Midlands	MFSC
R16	R: 8.45K ±¼% 1/8W	Electra/Midlands	MFSC
R16A	R: 412K ±1% 1/8W	Electra/Midlands	MFSC
R17	R: 6.81K ±¼% 1/8W	Electra/Midlands	MFSC
R17A	R: 412K ±1% 1/8W	Electra/Midlands	MFSC
R18	R: 6.65K ±¼% 1/8W	Electra/Midlands	MFSC
R18A	R: 294K ±1% 1/8W	Electra/Midlands	MFSC
R19	R: 6.04K ±¼% 1/8W	Electra/Midlands	MFSC
R19A	R: 274K ±1% 1/8W	Electra/Midlands	MFSC
R20	R: 6.19K ±¼% 1/8W	Electra/Midlands	MFSC
R20A	R: 374K ±1% 1/8W	Electra/Midlands	MFSC
R21	R: 4.87K ±¼% 1/8W	Electra/Midlands	MFSC
R22	R: 4.75K ±¼% 1/8W	Electra/Midlands	MFSC
R22A	R: 976K ±1% 1/8W	Electra/Midlands	MFSC
R23	R: 5.49K ±¼% 1/8W	Electra/Midlands	MFSC
R24	R: 5.36K ±¼% 1/8W	Electra/Midlands	MFSC
R24A	R: 750K ±1% 1/8W	Electra/Midlands	MFSC
R25	R: 17.4K 1% 1/8W	Elecrta/Midlands	MFSC
R25A	R: 500Ω Pot	80294	3007P-1-501
R26	R: 16.9K 1% 1/8W	Electra/Midlands	MFSC
R26A	R: 500Ω Pot	80294	3007P-1-501
R27	R: 15.4K 1% 1/8W	Electra/Midlands	MFSC
R27A	R: 500Ω Pot	80294	3007P-1-501
R28	R: 15.0K 1% 1/8W	Electra/Midlands	MFSC

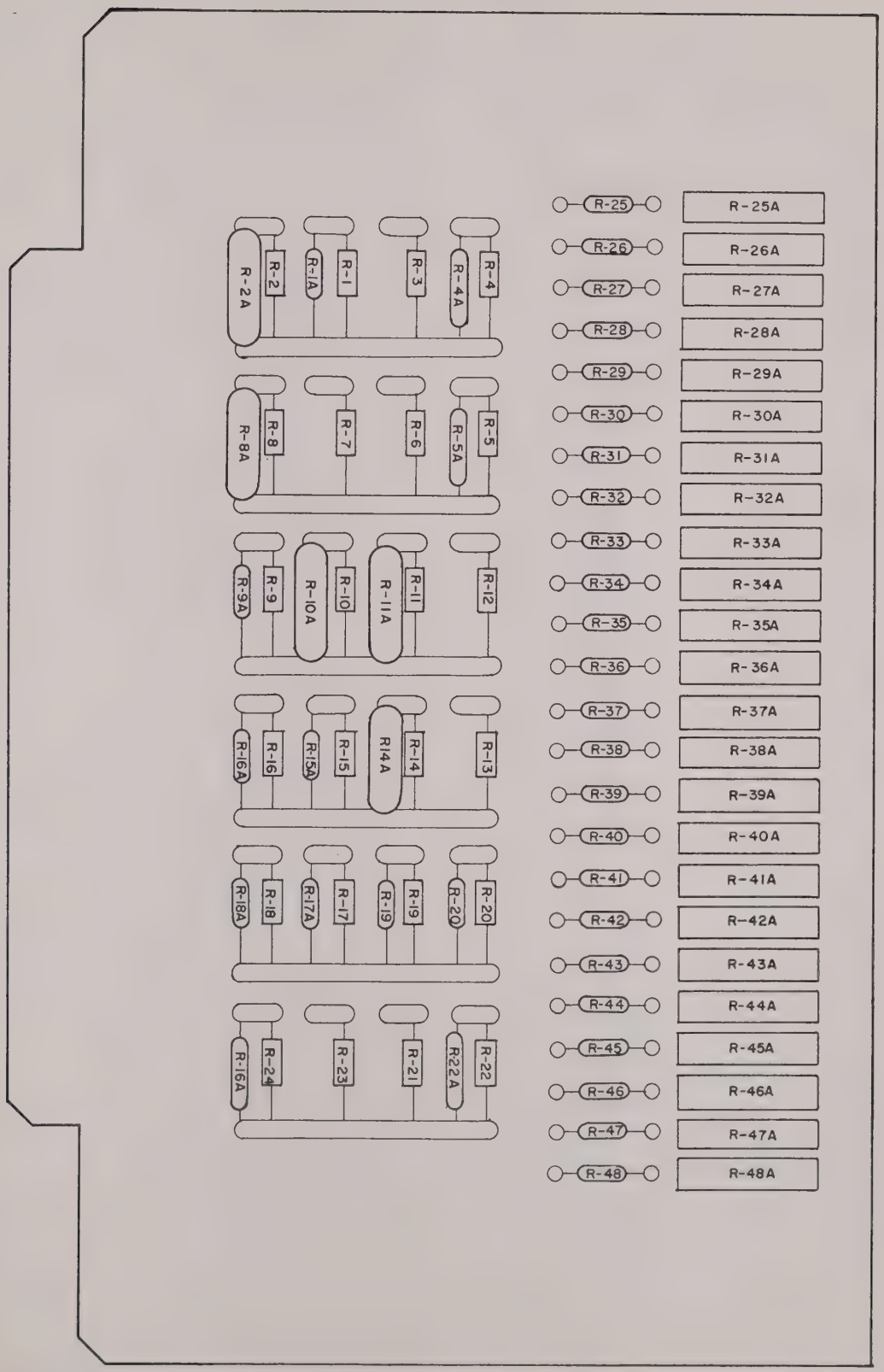


Figure 6-1 Component Location E95645

PC Board E95645 (E07-001-00-020) (cont)

Ref Desig.	Description	Manufacturer (FSCM Code No.)	Part Number
R28A	R: 500Ω Pot	80294	3007P-1-501
R29	R: 13.7K 1% 1/8W	Electra/Midlands	MFSC
R29A	R: 500Ω Pot	80294	3007P-1-501
R30	R: 13.3K 1% 1/8W	Electra/Midlands	MFSC
R30A	R: 500Ω Pot	80294	3007P-1-501
R31	R: 11.8K 1% 1/8W	Electra/Midlands	MFSC
R31A	R: 1K Pot	80294	3007P
R32	R: 11.3K 1% 1/8W	Electra/Midlands	MFSC
R32A	R: 1K Ω Pot	80294	3007P
R33	R: 11.0K 1% 1/8W	Electra/Midlands	MFSC
R33A	R: 500Ω Pot	80294	3007P-1-501
R34	R: 10.5K 1% 1/8W	Electra/Midlands	MFSC
R34A	R: 200Ω Pot	80294	3007P
R35	R: 9.53K 1% 1/8W	Electra/Midlands	MFSC
R35A	R: 500Ω Pot	80294	3007P-1-501
R36	R: 9.31K 1% 1/8W	Electra/Midlands	MFSC
R36A	R: 500Ω Pot	80294	3007P-1-501
R37	R: 8.45K 1% 1/8W	Electra/Midlands	MFSC
R37A	R: 200Ω Pot	80294	3007P
R38	R: 8.06K 1% 1/8W	Electra/Midlands	MFSC
R38A	R: 500Ω Pot	80294	3007P-1-501
R39	R: 7.15K 1% 1/8W	Electra/Midlands	MFSC
R39A	R: 500Ω Pot	80294	3007P-1-501
R40	R: 6.98K 1% 1/8W	Electra/Midlands	MFSC
R40A	R: 200Ω Pot	80294	3007P
R41	R: 6.49K 1% 1/8W	Electra/Midlands	MFSC
R41A	R: 500Ω Pot	80294	3007P-1-501
R42	R: 6.19K 1% 1/8W	Electra/Midlands	MFSC
R42A	R: 500Ω Pot	80294	3007P-1-501
R43	R: 5.90K 1% 1/8W	Electra/Midlands	MFSC
R43A	R: 200Ω Pot	80294	3007P
R44	R: 5.76K 1% 1/8W	Electra/Midlands	MFSC
R44A	R: 200Ω Pot	80294	3007P
R45	R: 5.36K 1% 1/8W	Electra/Midlands	MFSC
R45A	R: 200Ω Pot	80294	3007P
R46	R: 5.23K 1% 1/8W	Electra/Midlands	MFSC
R46A	R: 200Ω Pot	80294	3007P
R47	R: 4.75K 1% 1/8W	Electra/Midlands	MFSC
R47A	R: 200Ω Pot	80294	3007P
R48	R: 4.64K 1% 1/8W	Electra/Midlands	MFSC
R48A	R: 200Ω Pot	80294	3007P

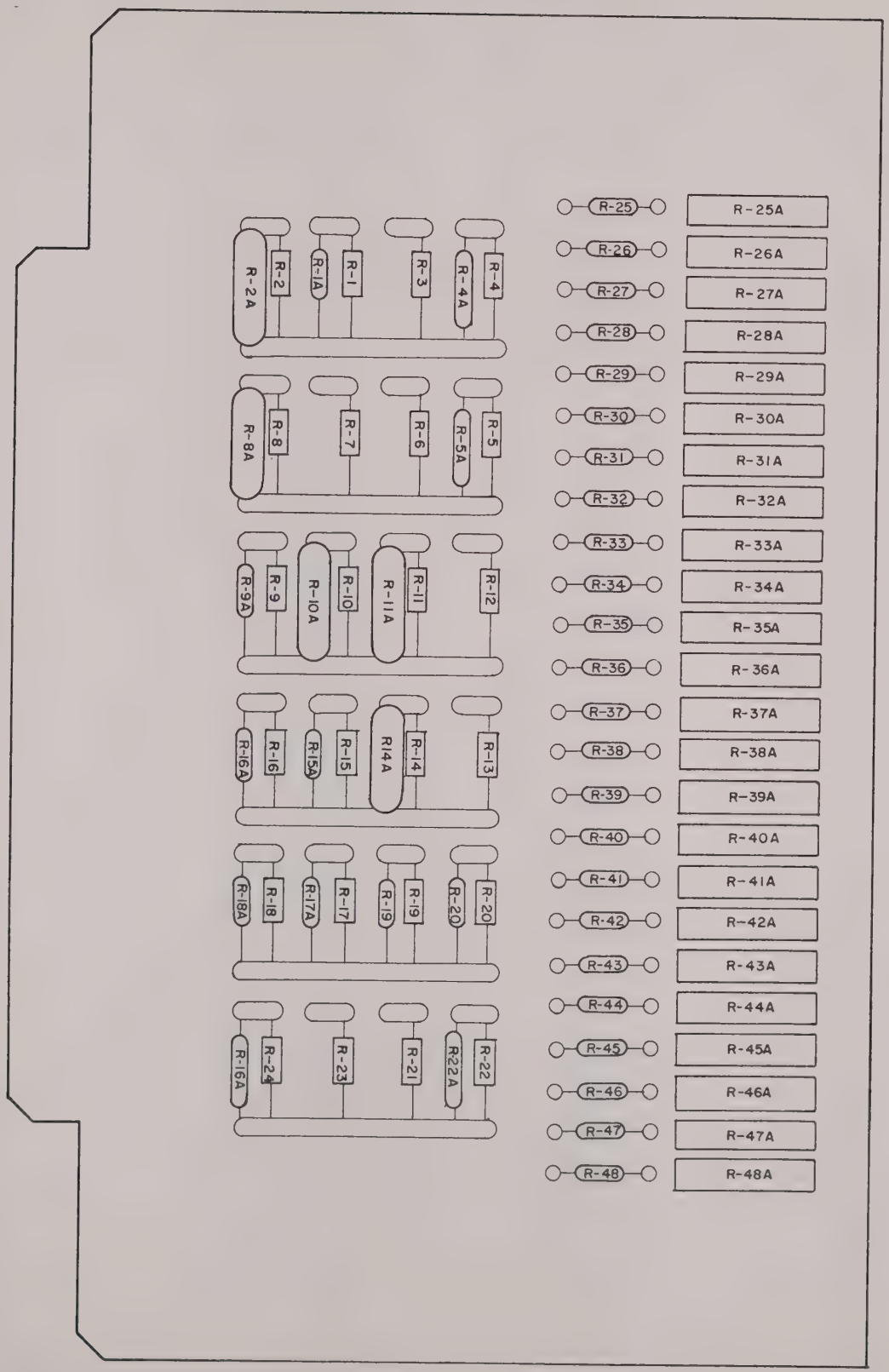


Figure 6-2 Component Location E95645 (sheet 2)

PC Board E95492-3

Ref Desig.	Description	Manufacturer (FSCM Code No.)	Part Number
T1	Pulse Transformer	18043	
R1	R: 3.3K ±10% ¼W	01121	CB
R2	R: 33K ± 10% ¼W	01121	CB
R3	R: 390Ω ±10% ¼W	01121	CB
R4	R: 1.5K ±10% ¼W	01121	CB
R5	R: 470Ω ±10% ¼W	01121	CB
R6	R: 2.2K ±10% ¼W	01121	CB
R7	R: 1K 20 Turn Pot 10%	80294	3007P-1-102
R8	R: 1K ±10% ¼W	01121	CB
R9	R: 18K ± 10% ¼W	01121	CB
R10	R: 1K ±10% ¼W	01121	CB
R11	R: 47K ±10% ¼W	01121	CB
R12	R: 47K ±10% ¼W	01121	CB
R13	R: 100K ±10% ¼W	01121	CB
R14	R: 2K ±1% 1/8W	06486	CEATO
R15	R: 13K ±1% 1/8W	06486	CEATO
R16	R: 13K ± 1% 1/8W	06486	CEATO
R17	R: 13K ±1% 1/8W	06486	CEATO
R18	R: 2K ±1% 1/8W	06486	CEATO
R19	Thermistor (30K)	06124	43R1
R20	R: 10K ±1% 1/8W	06486	CEATO
R21	R: 2K ±1% 1/8W	06486	CEATO
R22	R: 18K ±10% ¼W	01121	CB
R23 and R24	R: 1K 20 Turn Pot 10%	80294	3007P-1-102.
R25	not used		
R26	R: 100Ω ±10% ¼W	01121	CB
R27	R: 47Ω ±10% ¼W	01121	CB
R28	R: 47Ω ±10% ¼W	01121	CB
R29	R: 1K ±10% ¼W	01121	CB
C1	C: 68pF Silver Mica	72136	CM15E680J
C2	C: 1.0μF 35VDC	05397	K1W35K
C3	C: 68pF Silver Mica	72136	CM15E680J
C4	C: 0.1μF Disc. Cap. 75V	71590	DDA-104
C5	C: 0.01μF ±5% 35V	13606	490P
C6	C: 2.2μF 35VDC	05397	K2R2W35K
C7	C: 0.01μF ±5% 35V	13606	490P
C8	not used		
C9	C: 1.0μF 35VDC	05397	K1W35K
C10 and C11	C: 0.1μF Disc. Cap 75V	71590	DDA-104
C12	C: 22μF 6 VDC	05397	K22W6K
C13	not used		
C14	C: 15μF 10VDC	05397	K15W10K
C15	C: 0.47μF 25VDC	13606	5C11
TP1 thru TP5	Right Angle T.P.	17117	4879-125-9

PC Board E95492-3 (cont.)

Ref Desig.	Description	Manufacturer (FSCM Code No.)	Part Number
CR1 thru CR5	Silicon Sig. Diodes		1N4148
U1	Integrated Circuit	17117	SP333A
U2	Integrated Circuit	18324	SN7493N
U3	Integrated Circuit	18324	SP380A
U4	Integrated Circuit	18324	SP370A
U5	Integrated Circuit	18324	SP317A
U6	Integrated Circuit	18324	SP317A
U7	Integrated Circuit	18324	SP321A
U8	Integrated Circuit	18324	SP380A
U9	Integrated Circuit	18324	SP380A
U10	Integrated Circuit	01295	SN7401N
Q1, Q2, Q3	Transistor NPN Silicon	15873	MPS6515
Q4	Transistor NPN Silicon	15873	2N3903
Q5	Transistor PNP Silicon	15873	2N3905
Q6	Transistor PNP Silicon	15873	2N3905
Q7	Transistor NPN Silicon	15873	2N3903
Y1	1.544 MHZ Xtal	79066	VR6
XY1	Xtal Socket	91506	8000-DG3

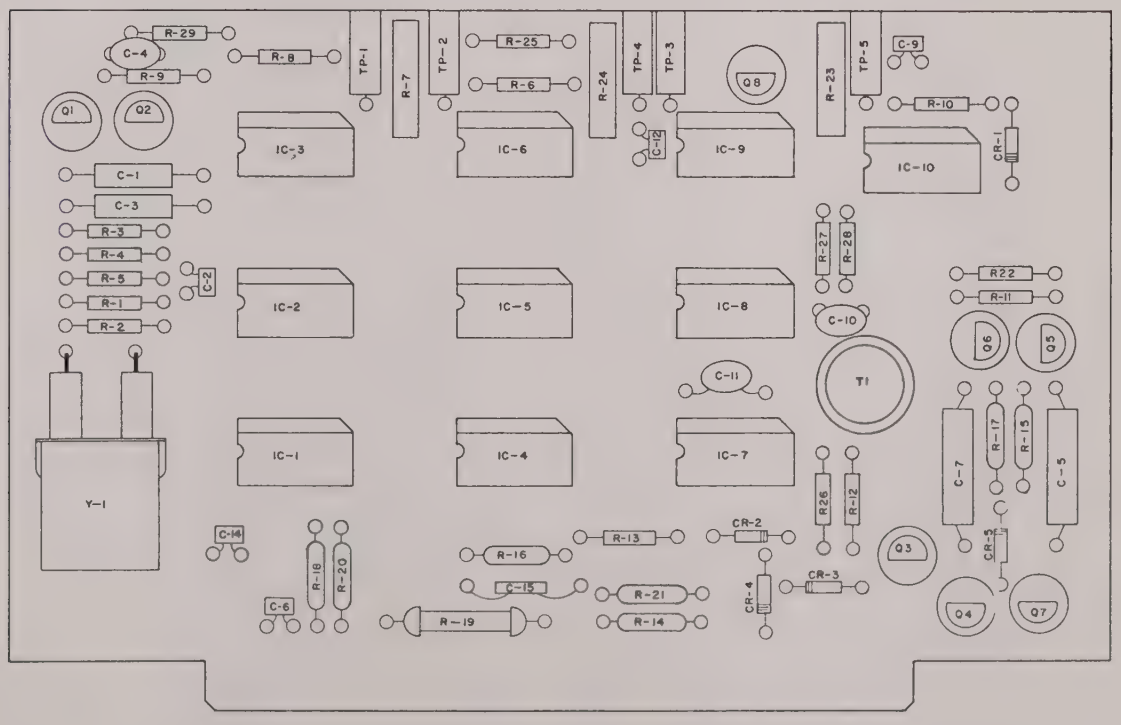


Figure 6-3 Component Location E95492-3

PC Board E07-001-00-021

Ref Desig.	Description	Manufacturer (FSCM Code No.)	Part Number
R1	R: 220K ±10% ¼W	01121	CB
R2	R: 220K ± 10% ¼W	01121	CB
R3	R: 100K ±10% ¼W	01121	CB
R4	R: 1.8K ±10% ¼W	01121	CB
R5	R: 1.8K ±10% ¼W	01121	CB
R6	R: 1.5K ±10% ¼W	01121	CB
R7	R: 1K ±1% 1/8W	06486	CEATO
R8	R: 316K ±1% 1/8W	06486	CEATO
R9	R: 301Ω ±1% 1/8W	06486	CEATO
R10 and R11	R: 1K ±10% ¼W	01121	CB
R12	R: 100K ±10% ¼W	01121	CB
R13	R: 4.42K ±1% 1/8W	06486	CEATO
R14	R: 7.87K ±1% 1/8W	06486	CEATO
R15	R: 1K P.C. Pot	06486	500
R16	R: 1.5K ±10% ¼W	01121	CB
R17	R: 100K ±10% ¼W	01121	CB
R18	R: 4.42K ±1% 1/8W	06486	CEATO
R19	R: 7.87K ± 1% 1/8W	06486	CEATO
R20	R: 1K P.C. Pot	06486	500
R21	R: 1.5K ±10% ¼W	01121	CB
R22	R: 220K ±10% ¼W	01121	CB
R23	R: 220K ±10% ¼W	01121	CB
R24	R: 100Ω ±10% ¼W	01121	CB
R25	R: 1K P.C. Pot	06486	CEATO
R26	R: 1/5K ±10% ¼W	01121	CB
R27 and R28	R: 220Ω ±10% ¼W	01121	CB
R29	R: 909Ω ±1% 1/8W	06496	CEATO
C1	C: 0.015μF 100VDC ±10%	13606	225P
C2	not used		
C3	C: 0.22μF 80VDC ±10%	13606	190P
C4	C: 2.2μF 100VDC ±10%	22650	51-6919
C4A	C: 1.0μF 25VDC	13606	5C13
C5	C: 8.2μF 15VDC	05397	K8R2W15K
C6	C: 510pF Disc	71590	DD-511
C7	C: 22pF Disc	71590	DD-220
C8	C: 8.2μF 15VDC	05397	K8R2W15K
C9	C: 8.2μF 15VDC	05397	K8R2W15K
C10	C: 0.1μF 100VDC ±10%	13606	225P
C11	C: 8.2μF 15VDC	05397	K8R2W15K
C12	not used		
C13	C: 510pF Disc	71590	DD-511
C14	C: 22pF Disc	71590	DD220
C15	not used		
C16	C: 0.05μF	13606	225P
C17	C: 8.2μF 15VDC	05397	K8R2W15K
C18	C: 22pF Disc	71590	DD-220
C19	C: 510pF Disc	71590	DD-511

PC Board E07-001-00-021 (cont)

Ref Desig.	Description	Manufacturer (FSCM Code No.)	Part Number
C20	not used		
C21	not used		
C22	C: 0.015μF 100VDC ±10%	13606	225P
C23	C: 22pFDisc	71590	DD-220
C24	C: 100Ω ±10% $\frac{1}{4}$W	01121	CB
C25	C: 20μF 50VDC	13606	TE1305
C26	C: 1μF Non Polar/25V	13606	5C13
L1	250mH Inductor	81095	EA250
Q1	Transistor	49671	2N2102
Q2	Transistor	15873	2N3903
Q3	Transistor	15873	2N3905
U1	Integrated Circuit	01295	SN72709N
U2	Integrated Circuit	01295	SN72709N
U3	Integrated Circuit	01295	SN72709N
U4	Integrated Circuit	01295	SN72709N
	I.C. Sockets	91506	314-AG1A
	Transistor Sockets	91662	05-3303
CR1 and CR2	Silicon Signal Diodes		1N4148

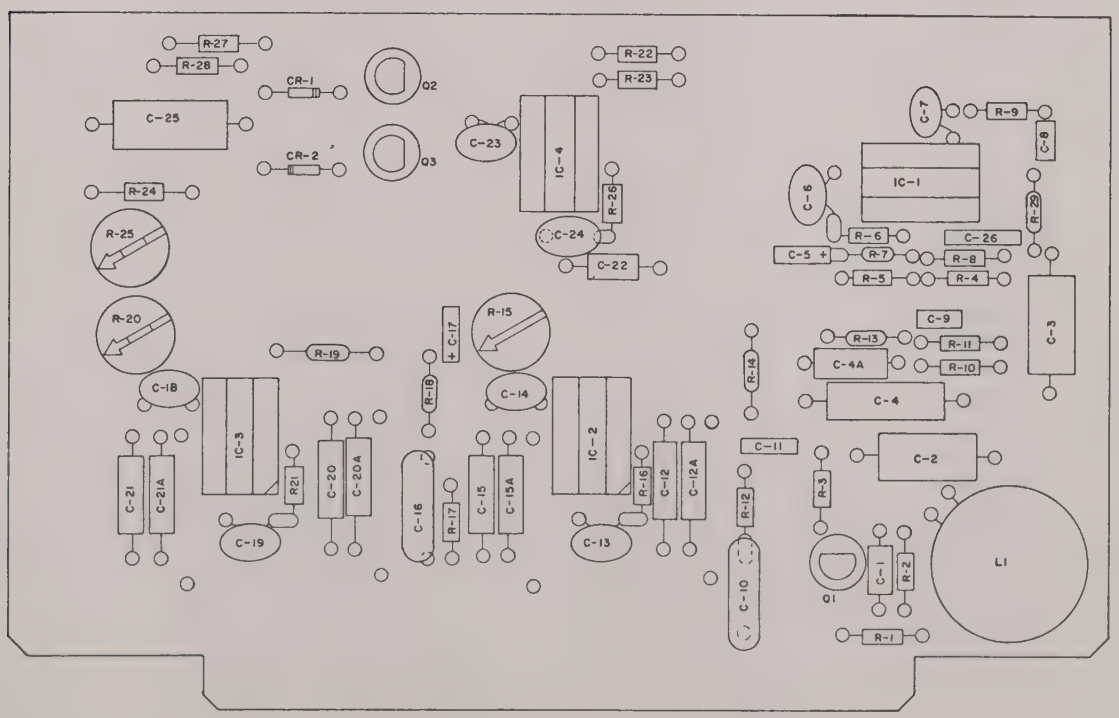


Figure 6-4 Component Location E07-001-00-021

PC Board E07-001-00-014

Ref Desig.	Description	Manufacturer (FSCM Code No.)	Part Number
R1	R: 1.5K ±10% ½W	01121	CB
R2	R: 6.49K ±1% 1/8W	06486	CEATO
R3	R: 1K P.C. Pot ±30%	71450	UPE200RE1
R4	R: 2.26K ±1% 1/8W	06486	CEATO
R5	R: 22K ±10% ½W	01121	CB
R6	R: 2.7K ±10% ½W	01121	CB
R7	R: 100Ω ±10% ½W	01121	CB
R8	R: 100Ω ± 10% ½w	01121	CB
R9	R: 1K ±10% ½W	01121	CB
R10	R: 1K ±10% ½W	01121	CB
R11 and R12, R13	R: 100Ω ±10% ½W	01121	CB
R14	R: 1K ±10% ½W	01121	CB
R15	R: 3.9K ±10% ½W	01121	CB
R16	R:1Ω ±5% 3W	13606	242E1R05
R17	R: 1.8K ±10% ½W	01121	CB
R18	R: 1K P.C. Pot ±30%	71450	UPE200RE1
R19	R: 1.8K ±10% ½W	01121	CB
C1	C: 250μF 50VDC	13606	39D257G050HE4
C2	C: 510pF Silver Mica 500V	72136	CM15-E511J
C3	C: 250μF 50VDC	13606	39D257G050HE4
C4	C: 1000μF 12 VDC	05844	9-85PSD1000
C5	C: 500μF 25VDC	13606	39D507G025HE4
U1	Integrated Circuit	17803	U5R7-723
Q1	Transistor	49671	40372
Q2	Transistor	49671	2N3055
Q3	Transistor	15873	MPS6515
Q4	Transistor	15873	MPS6515
Q5	Transistor	15783	MPS6515
Q6	Transistor	15873	MPS6515
CR1	Silicon Signal Diode	12065	1N4003
CR2	Silicon Signal Diode	12065	1N4003
CR3	Silicon Signal Diode	12065	1N4003
CR4	Silicon Signal Diode	12065	1N4003
CR5	Silicon Signal Diode	12065	1N4003
CR6	Silicon Signal Diode	12065	1N4003
CR7	Silicon Signal Diode	12065	1N4003
CR8	Silicon Signal Diode	12065	1N4003
CR9	Small Signal Diode	12065	1N4148
CR10	Small Signal Diode	12065	1N4148
CR11	Small Signal Diode	12065	1N4148
CR12	Small Signal Diode	12065	1N4148
CR13	Small Signal Diode	12 065	1N4148

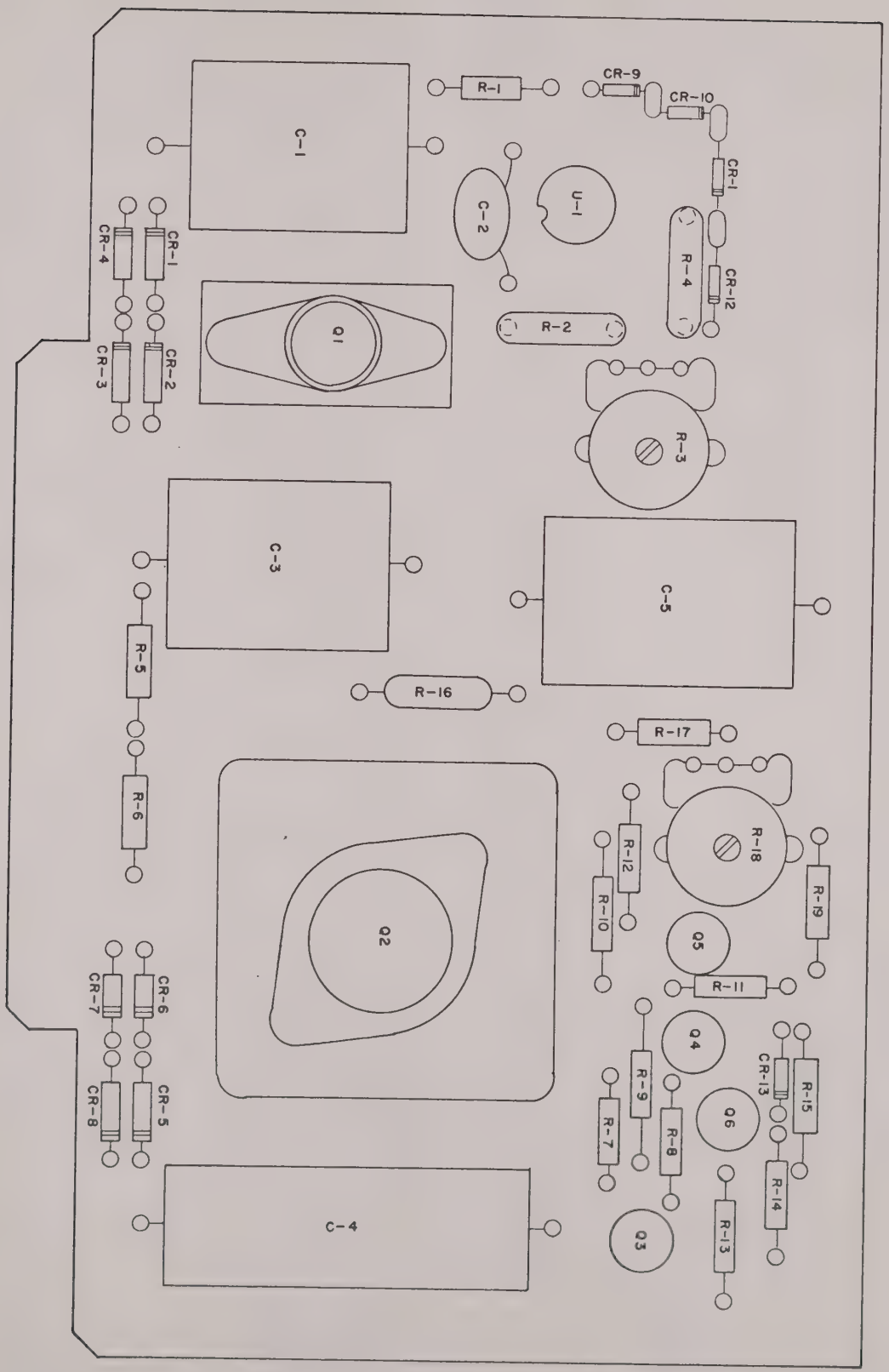


Figure 6-5 Component Location E07-001-00-014

PC Board E07-001-00-018
and E07-001-00-019

Ref Desig.	Description	Manufacturer (FSCM Code No.)	Part Number
R1	R: 44.2K $\frac{1}{4}$W $\pm$1%	Electra/Midlands	MF5C
R1A	R: 1.05M $\frac{1}{4}$W $\pm$1%	Electra/Midlands	MF6C
R2	R: 37.4K 1/8W $\pm$1%	Electra/Midlands	MF5C
R2A	R: 1.96M $\frac{1}{4}$W $\pm$1%	Electra/Midlands	MF6C
R3	R: 31.6K 1/8W $\pm$1%	Electra/Midlands	MF5C
R3A	R: 2.0M $\frac{1}{4}$W $\pm$1%	Electra/Midlands	MF6C
R4	R: 26.1K 1/8W $\pm$1%	Electra/Midlands	MF5C
R4A	R: 909K 1/8W $\pm$1%	Electra/Midlands	MF5C
R5	R: 21.5K 1/8W $\pm$1%	Electra/Midlands	MF5C
R6	R: 17.8K 1/8W $\pm$1%	Electra/Midlands	MF5C
R7	R: 14.3K 1/8W $\pm$1%	Electra/Midlands	MF5C
R7A	R: 1.0M $\frac{1}{4}$W $\pm$1%	Electra/Midlands	MF6C
R8	R: 10.5K 1/8W $\pm$1%	Electra/Midlands	MF5C
R9	R: 8.66K 1/8W $\pm$1%	Electra/Midlands	MF5C
R10	R: 6.98K 1/8W $\pm$1%	Electra/Midlands	MF5C
R10A	R: 475K 1/8W $\pm$1%	Electra/Midlands	MF5C
R11	R: 5.23K 1/8W $\pm$1%	Electra/Midlands	MF5C
R11A	R: 383K 1/8W $\pm$1%	Electra/Midlands	MF5C
R12	R: 3.48K 1/8W $\pm$1%	Electra/Midlands	MF5C
R12A	R: 475K 1/8W $\pm$1%	Electra/Midlands	MF5C
S2	Push Button Switch	71590	

PC Board E07-001-00-016

Ref Desig.	Description	Manufacturer (FSCM Code No.)	Part Number
S1	Push Button Switch	71590	S-7001-016
R29	R: 2.26K $\pm$1% 1/8W	Electra/Midlands	MF5C
R30	R: 1.0K $\pm$1% 1/8W	Electra/Midlands	MF5C
R31	R: 604Ω $\pm$1% 1/8W	Electra/Midlands	MF5C
R32	R: 392Ω $\pm$1% 1/8W	Electra/Midlands	MF5C
R33	R: 267Ω $\pm$1% 1/8W	Electra/Midlands	MF5C
R34	R: 187Ω $\pm$1% 1/8W	Electra/Midlands	MF5C
R35	R: 127Ω $\pm$1% 1/8W	Electra/Midlands	MF5C

PC Board E95284

Ref Desig.	Description	Manufacturer (FSCM Code N0.)	Part Number
L1	Molded Inductor	76493	9350-08
L2	Molded Inductor	76493	9350-08
C1	Disc Capacitor 1KV	71590	DD-471
C2	Disc Capacitor 1KV	71590	DD-471

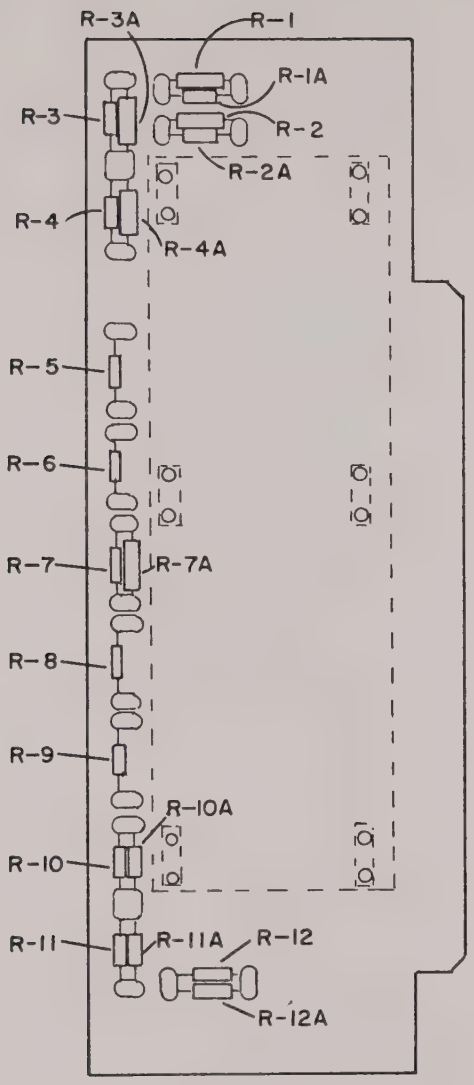


Figure 6-6 Component Location E07-001-00-018 and E07-001-00-019

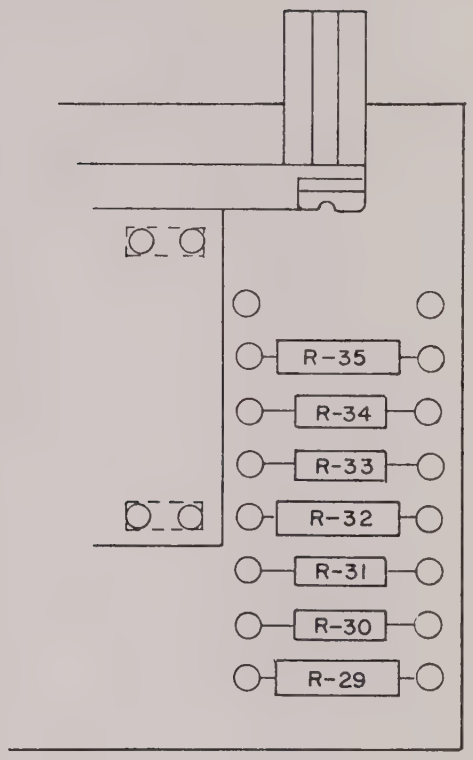


Figure 6-7 Component Location E07-001-00-016

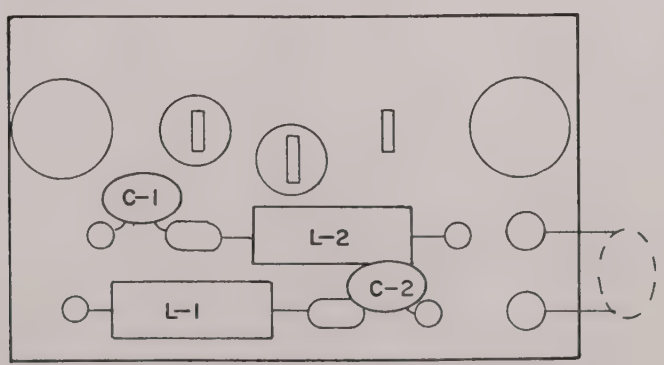


Figure 6-8 Component Location E95284

Attenuator Switch Assembly

Ref Desig.	Description	Manufacturer (FSCM Code No.)	Part Number
R101	R: 187Ω ±1% 1/8W	06486	CEATO
R102	R: 18.2Ω ±1% 1/8W	06486	CEATO
R103	R: 187Ω ±1% 1/8W	06486	CEATO
R104	R: 150Ω ±1% 1/8W	06486	CEATO
R105	R: 619Ω ±1% 1/8W	06486	CEATO
R106	E: 196Ω ±1% 1/8W	06486	CEATO
R106A	R: 23.7K ±1% 1/8W	06486	CEATO
R107	R: 51.9Ω ±1% 1/8W	06486	DEATO
R108	R: 19.6Ω ±1% 1/8W	06486	CEATO
R108A	R: 237Ω ±1% 1/8W	06486	CEATO
R109	R: 9.09Ω ±1% 1/8W	06486	CEATO
R109A	R: 909Ω ±1% 1/8W	06486	CEATO
R110	Pot. 750Ω	71590	HMS-750Ω
	Pot. Knob	49956	70-1WD-2
	Switch Knob	49956	70B-3-2
	11 Pos. 4 Pole Pot.	76854	269263-F4

PC Board E95641 (E07-001-00-015)

Ref Desig.	Description	Manufacturer (FSCM Code No.)	Part Number
C1	C: 100μF 50VDC	22650	24-437-100-50-8NA
C2	C: 100μF 50VDC	22650	24-437-100-50-8NA

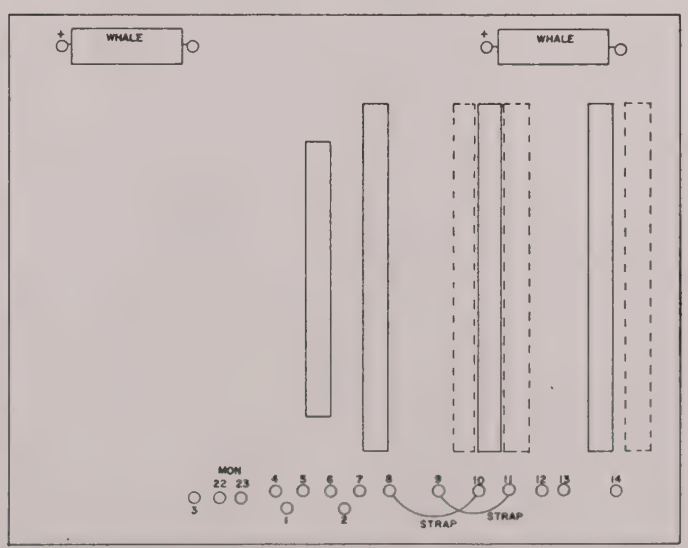


Figure 6-9 Component Location E95641

MAIN ASSEMBLY

Ref Desig.	Description	Manufacturer (FSCM Code No.)	Part Number
T1	Input Transformer	80223	A-20
T2	Power Transformer	17538	NEC-1
R1	R: 464Ω 1/8W ±1%	06486	CEATO
R2	R: 464Ω 1/8W ±1%	06486	CEATO
C1	C: 0.33μF 200VDC	13606	2PS-P33
M1	Meter	06555	6888-00
J1, J2, J3, J4	Panel Jacks	82389	12B
F1	Fuse	71400	3AG-1/10A
S4	Switch	09353	7101HP
L1	Lamp	71744	NE2D
R3	R: 3.9K ½W ±10%	01121	CB

SECTION 7

SCHEMATIC DIAGRAMS

7.1 INTRODUCTION. The following pages contain the schematic diagrams for the MODEL 7001.

FREQ CENTER	HIGH & LOW FREQ	NOMINAL VAL.IN KΩ	BASE-(KΩ) R-¼%		PADDER R-1%		BASE-(KΩ) R-1%		TRIM POTENTIOMETERS	
A	Low 820.5	17.642	R-1	17.8	R1A	2.0M	R25	17.4	R25A	500Ω
832	High 844.5	17.150	R-2	17.4	R2A	1.21M	R26	16.9	R26A	500Ω
B	L 914.0	15.838	R-4	16.2	R4A	715K	R27	15.4	R27A	500Ω
928	H 942.0	15,367	R-3	15.4			R28	15.0	R28A	500Ω
C	L 1032	14.027	R-7	14.0			R29	13.7	R29A	500Ω
1048	H 1064	13.685	R-8	13.7	R8A	1.50M	R30	13.3	R30A	500Ω
D	L 1188	12.185	R-5	12.4	R5A	698K	R31	11.8	R31A	1K
1206	H 1224	11.826	R-6	11.8			R32	11.3	R32A	1000Ω
E	L 1320	10.966	R-10	11.3	R10A	374K	R33	10.5	R33A	1K
1340	H 1360	10.644	R-9	11.0	R9A	332K	R34	10.2	R34A	500Ω
F	L 1485	9.748	R-12	9.76			R35	9.53	R35A	500Ω
1508	H 1531	9.455	R-11	9.53	R11A	1.21M	R36	9.21	R36A	500Ω
G	L 1696	8.535	R-15	8.66	R15A	590K	R37	8.45	R37A	200Ω
1722	H 1748	8.281	R-16	8.45	R16A	412K	R38	8.06	R38A	500Ω
H	L 1978	7.318	R-13	7.32			R39	7.15	R39A	500Ω
2008	H 2038	7.103	R-14	7.15	R14A	1.07M	R40	6.98	R40A	200Ω
J	L 2160	6.701	R-17	6.81	R17A	412K	R41	6.49	R41A	500Ω
2193	H 2226	6.503	R-18	6.65	R18A	294K	R42	6.19	R42A	500Ω
K	L 2377	6.090	R-20	6.19	R20A	374K	R43	5.62	R43A	500Ω
2413	H 2449	5.910	R-19	6.04	R19A	274K	R44	5.62	R44A	500Ω
L	L 2640	5.483	R-23	5.49			R45	5.36	R45A	200Ω
2680	H 2720	5.322	R-24	5.36	R24A	750K	R46	5.23	R46A	200Ω
M	L 2972	4.870	R-21	4.87			R47	4.75	R47A	200Ω
3017	H 3062	4.727	R-22	4.75	R22A	976K	R48	4.64	R48A	200Ω

E-07-001-00-020-1 SELECTOR BOARD

Figure 7-1 Selector Switch Boards

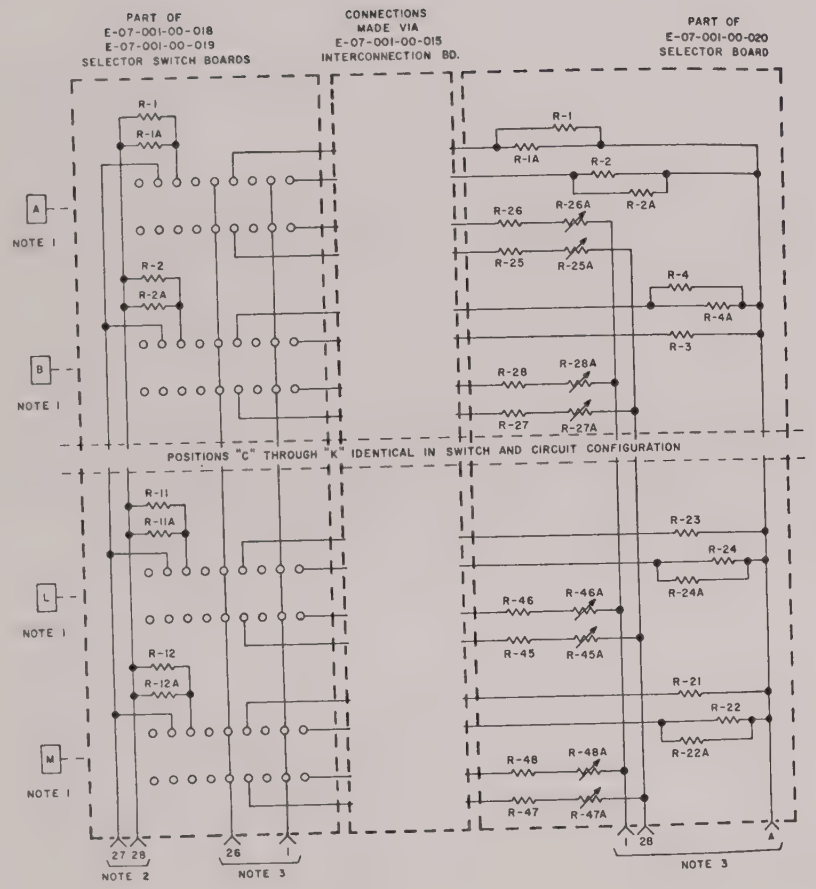
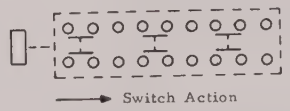


Figure 7-1 Selector Switch Boards

NOTE 1: SWITCH EXPLANATION. Each section of the switch is made up of six "C" contacts that are all operated simultaneously when the SECTIONS button is depressed. All 12 of these sections are interlocked in such a way that normally only one section can be engaged at any time. By depressing any disengaged sections button (in the direction of the arrows), the contacts become engaged and disengaged the previously engaged section.



NOTE 2: Pins 27 and 28 are connected via E-07-001-00-015 Interconnections board to pins B and C respectively of E95492 Signal Generator. The resistances (R1 thru R12A) determine the frequency of the systems audio modulator.

NOTE 3: These pins are connected via E-07-001-00-015 Interconnection board to Filter/Detector board to determine the frequency of the receive filters.

E-07-001-00-018---E-07-001-00-021 (Filter/Detector Board)

Pin 26----------Pin 23

Pin 1----------Pin 1

E-07-001-00-020---E-07-001-00-021 (Filter/Detector Board)

Pin 28----------Pin 14

Pin 1----------Pin 4

Pin A----------Pin 21

Figure 7-2 Model 7001 Interconnection Diagram

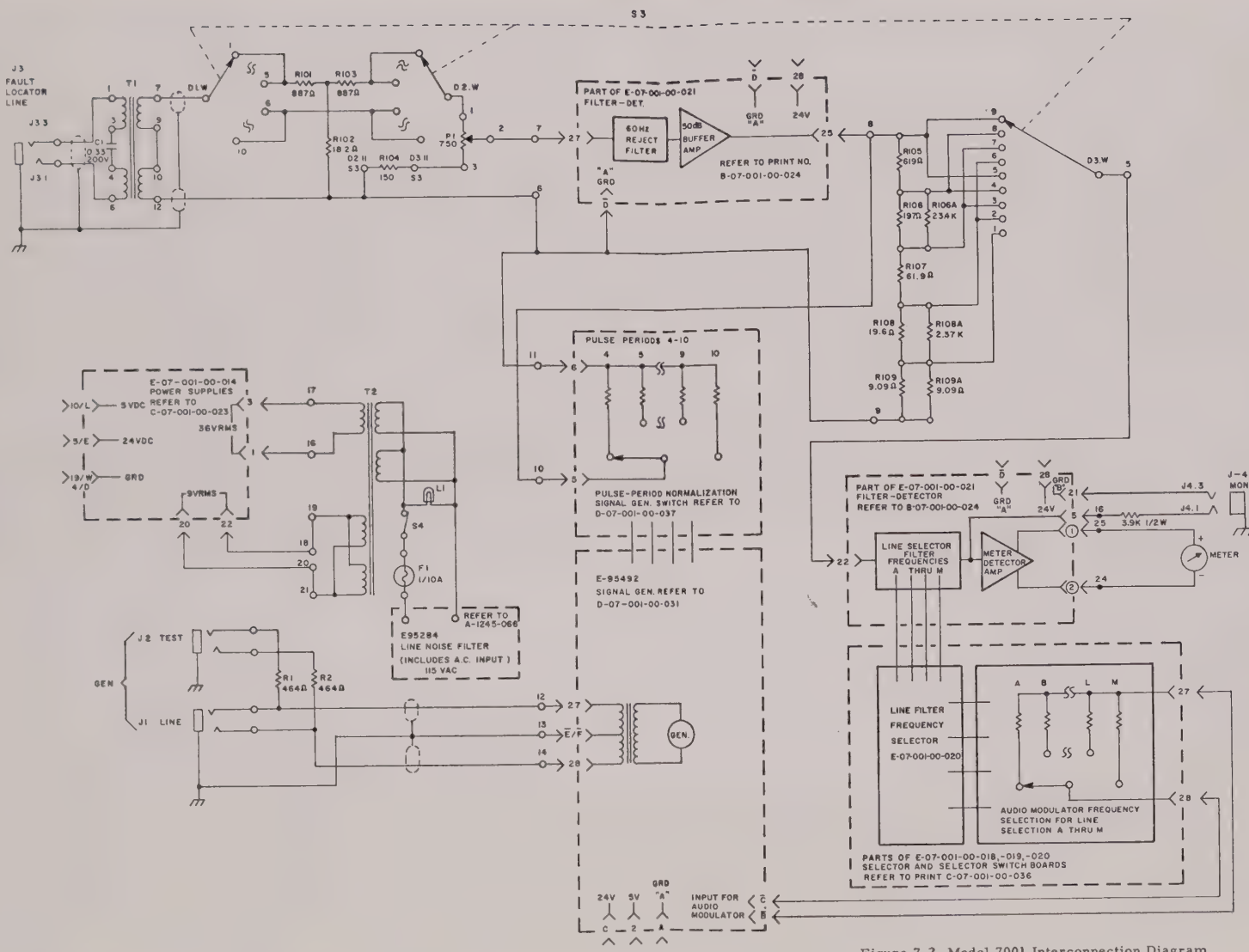


Figure 7-2 Model 7001 Interconnection Diagram

Figure 7-3 Signal Generator Schematic Diagram

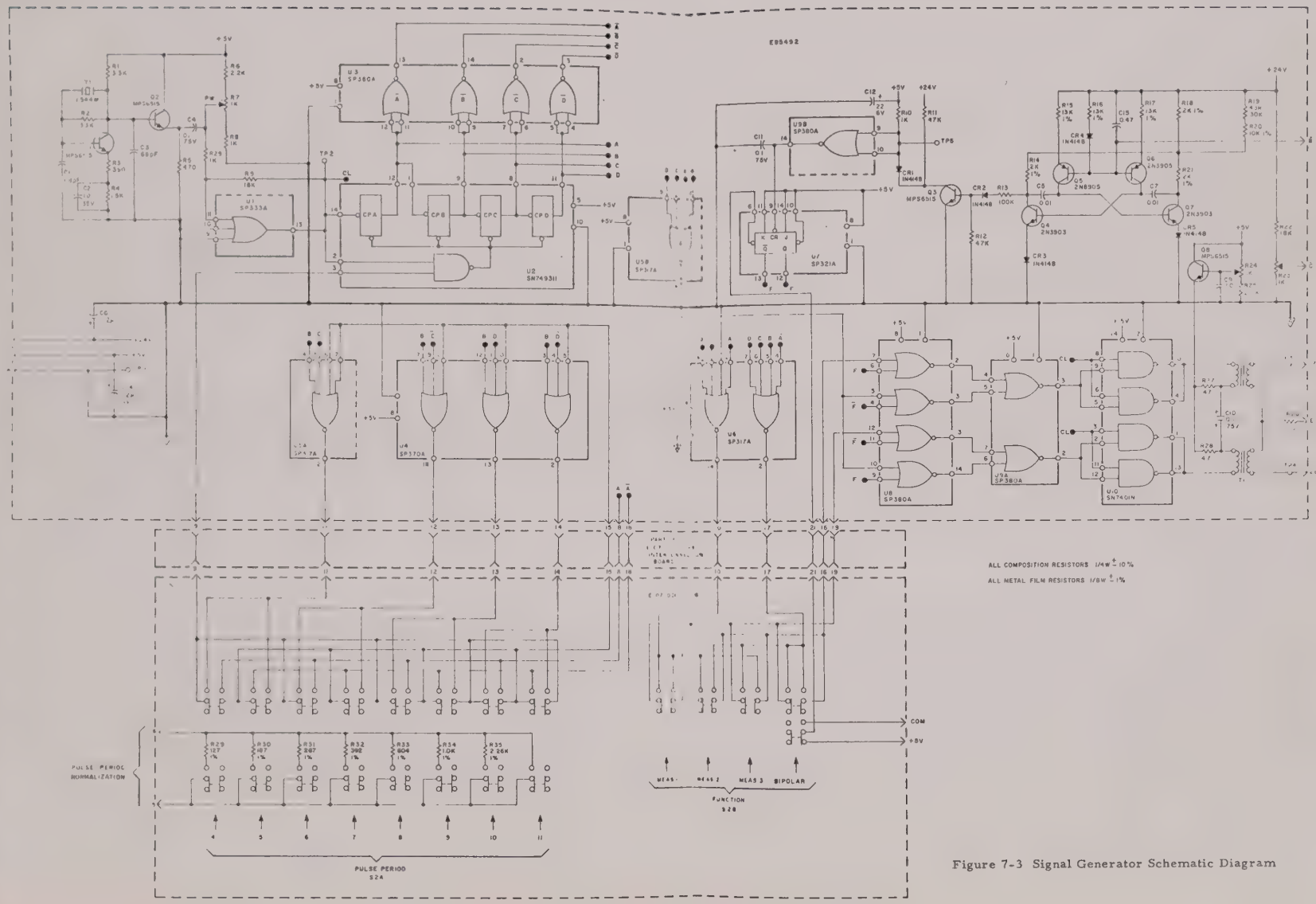


Figure 7-3 Signal Generator Schematic Diagram

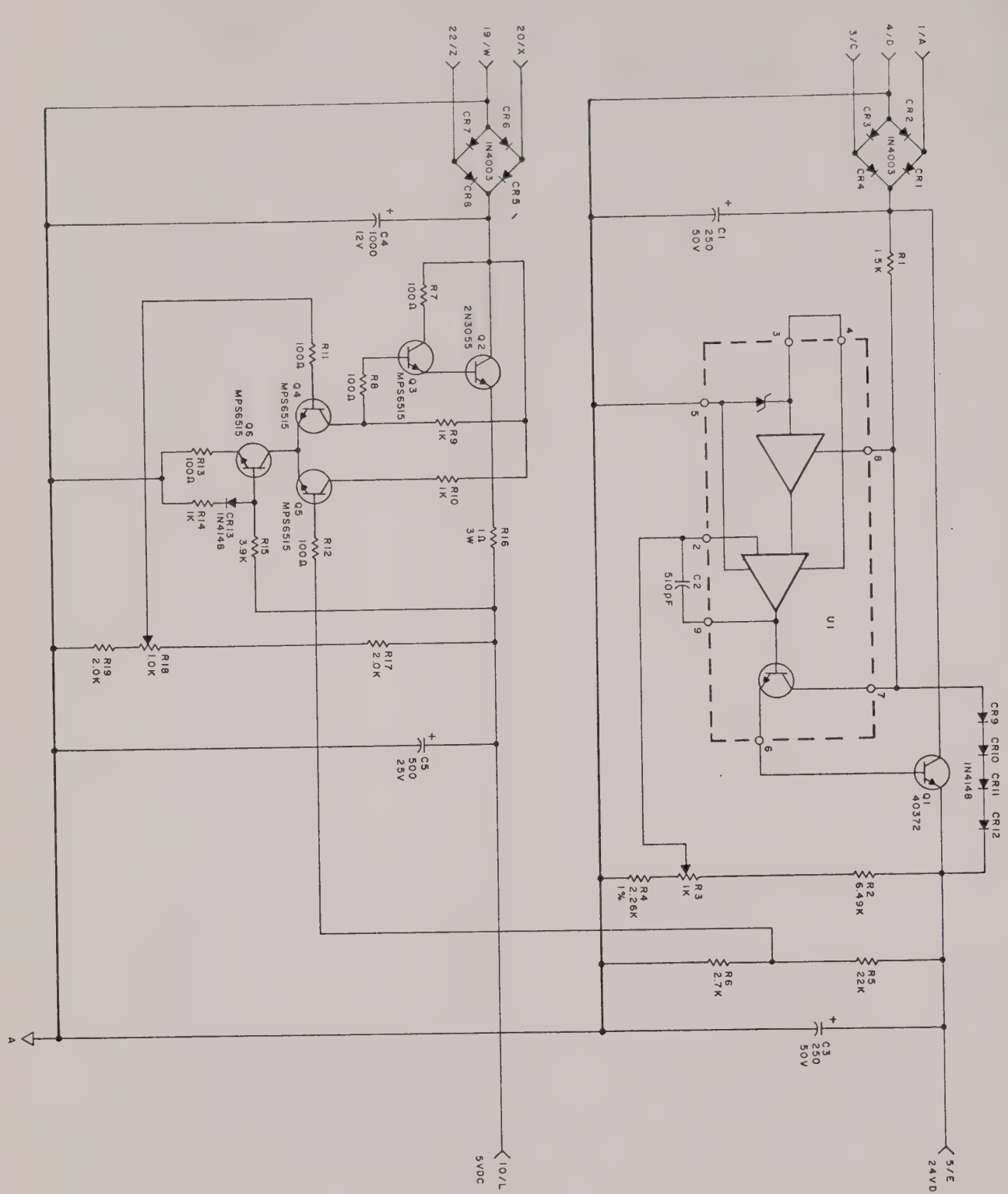


Figure 7-4 Power Supplies Schematic Diagram

Figure 7-5 Filter Detector Schematic Diagram